SC-30™ SERIES

Portable Field Standard

Models: SC-30-RQ™ / SC-30CT-RQ™

INSTRUCTION
MANUAL

JEMTEC

JEMTEC

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Electronic Services - Los Angele
M13775X

Esterline JEMTEC

WARRANTY

Seller warrants its Equipment to meet applicable specifications, if any, and to be free from defects in material and workmanship for a period of one (1) year from date of shipment to the original Purchaser. Upon receipt of prompt written notice from Purchaser, referencing the order number and detailing the claimed non-conformity or defect, Seller shall, at its option, repair or replace the Equipment. Inbound shipping charges to Seller's factory in Columbus, Ohio or other designated facility are the responsibility of Purchaser. Normal shipping charges for the return to the Purchaser of repaired or replacement Equipment shall be the responsibility of the Seller (North American points only).

Repair or replacement of the Equipment in the manner above is the exclusive warranty remedy and shall constitute complete fulfillment of all Seller's liabilities for breach of this Warranty. Seller assumes no responsibility hereunder for any Equipment damage or failure caused by (a) improper installation, operation or maintenance of the Equipment; or (b) normal wear and tear on disposable and/or consumable parts. This Warranty shall be void in the event of unauthorized modification or servicing of the Equipment.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTIES OF QUALITY, WHETHER EXPRESS OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE). In no event shall Seller be liable hereunder for any special, indirect, incidental, or consequential damages including but not limited to loss of revenues or production.

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Instruction Manual

Introduction

The JEMTEC SC-30™ Series of Portable Multifunction Field Standards are designed for field testing of Watthour, Varhour and Qhour meters. SC-30 Series Portable Multifunction Field Standards include the following features:

- Watthour, Varhour and Qhour measurements
- Full autoranging for current and potential inputs and auxiliary power
- A backlit LCD readout
- A maximum resolution to 10 μ (0.00001) Watthours, 10 μVarhours or 10 μQhours

The Portable Multifunction Field Standard is available in two models:

- SC-30-RQ™ Current Terminal
- SC-30CT-RQ™ with Current Tunnel™ measurement window

Both models support closed-link testing of solid-state and electromechanical meters.

Energy measured by the field standard is compared to the same amount of energy measured by the meter being tested. From these two values, the relative accuracy of the meter being tested can be determined.

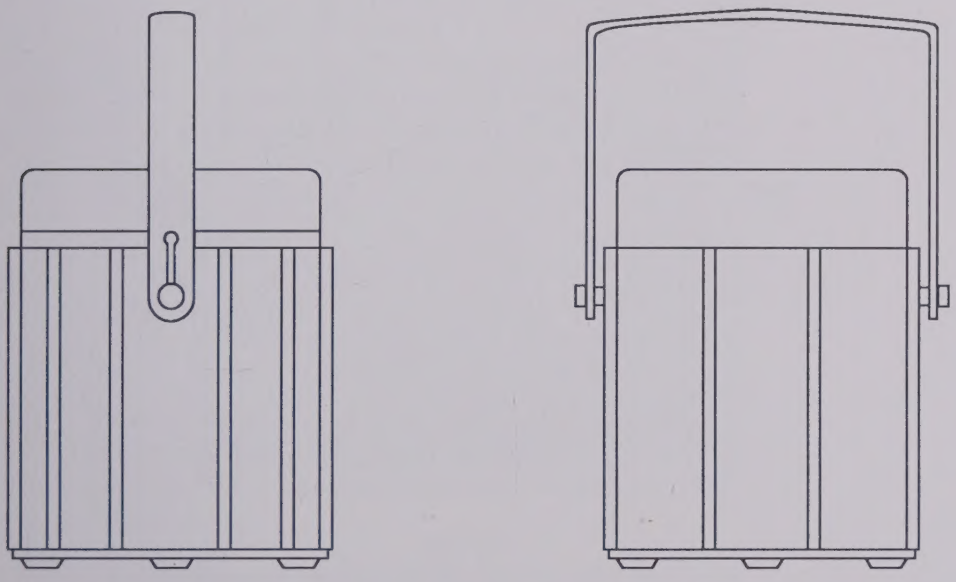

Figure 1.
The SC-30-RQ Portable Multifunction Watthour, Varhour, Qhour Field Standard

Instruction Manual

Introduction

Organization of Manual

This manual is designed for personnel responsible for the initial setup, testing, and installation of solid-state and electromechanical meters. The user should be familiar with accepted metering practices and safety measures.

This manual is divided into six sections:

Introduction
Physical Description
General Operation
Testing Instructions
Display Messages
Connection Diagrams

For More Information

For technical assistance, contact your local JEMTEC representative or JEMTEC's Customer Support Group at (614) 274-0400. Fax: (614) 272-2288.

Physical Description

The SC-30-RQ is housed in an aluminum case with a leather carrying strap and removable polycarbonate lid. The control panel contains:

- Optical Port
- Backlit LCD display
- Display Reset/Choose button
- Gate input
- Case ground terminal
- Pulse outputs
- Fuse holders for voltage and auxiliary inputs
- Autoranging current, voltage, and auxiliary power terminals

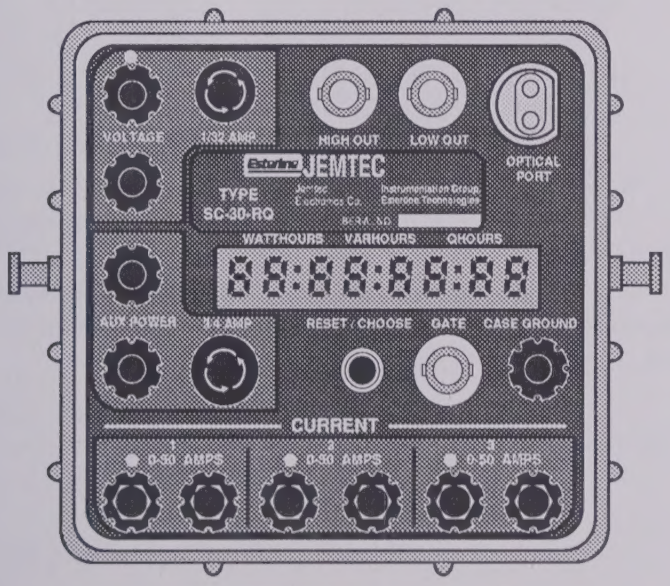

Figure 2.
Control Panel of SC-30-RQ Current Terminal Model

Physical Description

The Current Input Terminals are eliminated on the SC-30CT-RQ™ model (See Figure 3).

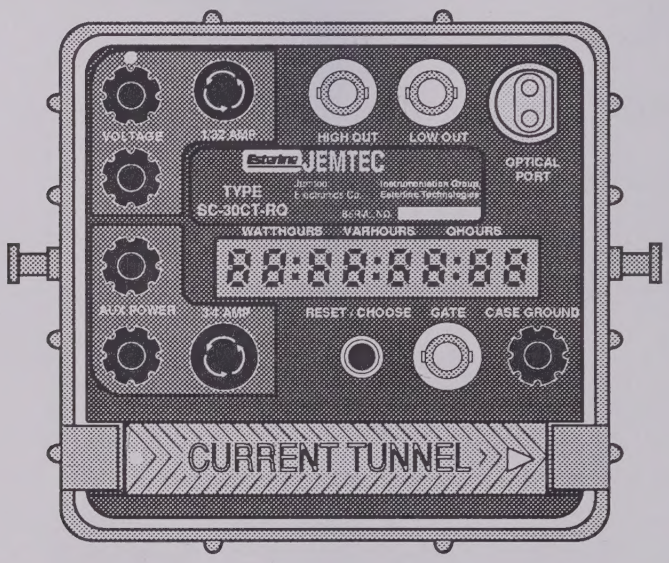

Figure 3.
Control Panel of SC-30CT-RQ Model with Current Tunnel™ Measurement Window

Specifications

Input Ratings:

Potential Input

Operating Range	60 to 600 Vrms
Frequency	Watthours, 60 ±2 Hz *
	Varhours & Qhours, 60.00 Hz *†
Maximum Continuous Voltage	600 Vrms
Burden @ 600 Volts	< 2.0 VA (V^2 / Z)
Impedance	16K - j256K Ohms
Fuse	1/32 Amp, 3AG, 250 V

Current Input

SC-30-RQ Model

Operating Range	0.2 to 50 Amps rms / Input
Frequency	Watthours, 60 ±2 Hz *
	Varhours & Qhours, 60.00 Hz *†
Overload, Continuous	70 Amps rms
Burden @ 50 Amps	1.3 VA typical (I^2R)

SC-30CT-RQ Model

Operating Range	0.2 to 150 Amps rms
Frequency	Watthours, 60 ±2 Hz *
	Varhours & Qhours, 60.00 Hz *†
Overload, Continuous	200 Amps rms
Burden	Dependent upon customer selected conductor size and type (I^2R)

* 50 Hz operation optional

† For frequencies other than the rated 60 Hz (i.e. 58 - 62 Hz) or 50 Hz (i.e. 48 - 52 Hz) a Varhour correction factor may be applied as follows:

Display Varhours × (Actual Test Frequency / 60) = Varhours

For 50 Hz units, substitute 50 in place of 60 in this equation. The test meter may also have a frequency influence which must be considered during calibration.

Physical Description

Specifications (cont.)

Auxiliary Power Input			
Operating Range		80 to 520 Vrms	
Frequency		48 to 62 Hz	
Burden @	120 V	7.2 Watts	12.2 VA
	240 V	7.3 Watts	13.4 VA
	480 V	8.2 Watts	13.8 VA
Fuse		Buss MDL-3/4, 3/4 Amp	

NOTE: FOR OPERATION ABOVE 250 VAC

This unit is designed and tested for operation to 600 VAC. However, because the unit is provided with 250 VAC fuses and the nature of electrical faults above the critical arcing voltage of about 300 VAC, the user should consider the following external fusing scheme for additional operator safety:

1) An external time-delay fuse rated at 600 VAC and 1 Ampere in series with Auxiliary Power, and

2) an external time-delay fuse rated at 600 VAC and 1 Ampere in series with Potential Signal.

Gate (Snap Switch) Input	
Contact Cleaning Current	1.0 Amp Peak exponential 15 µseconds / Time Constant
Steady State Current	5.0 mA steady state
Open Circuit Voltage	15 Vdc

Specifications (cont.)

Output Ratings:

Digital Display	8 digit, 7 segment LCD, 0.5" high character with floating decimal point and LED backlight.
Range	0.00000 to 99999999. Watthours, Varhours or Qhours

High Pulse Output

Pulse Value	10 µWatthours, 10 µVarhours or 10 µQhours / pulse asserted low
Pulse Duration	100 nanoseconds typical

High Pulse Output Open Collector Ratings @ 25°C

V_{ce} (maximum)	26 Vdc
V_{ce} (saturation)	0.4 V at 30 mAdc 1.0 V at 50 mAdc
I_c (maximum)	50.0 mAdc

Low Pulse Output

Pulse Value	1 mWatthour, 1mVarhour or 1mQhour / pulse asserted low
Pulse Duration	19 µseconds typical

Low Pulse Output Open Collector Ratings @ 25°C

V_{ce} (maximum)	26 Vdc
V_{ce} (saturation)	0.4 V at 5 mAdc 2.0 V at 10 mAdc
I_c (maximum)	10.0 mAdc

Physical Description

Specifications (cont.)

Open Collector Outputs

The open collector outputs provide isolation between the SC-30-RQ and any external counting device compatible with the pulse output specifications. Please *note* that the high pulse output is electrically common to the gate input; however, the high pulse output is isolated from all other inputs and outputs and the case. The low pulse output is fully isolated. The pulse outputs are obtained via BNC connectors on the SC-30-RQ control panel.

The outputs are dependent on an external voltage supply and limiting resistor to develop an output. Some pulse comparators (counters) provide a voltage source when they are connected to the SC-30-RQ output connections. If one is not available, an external power source may be constructed as shown in Figure 4 on the following page.

Specifications (cont.)

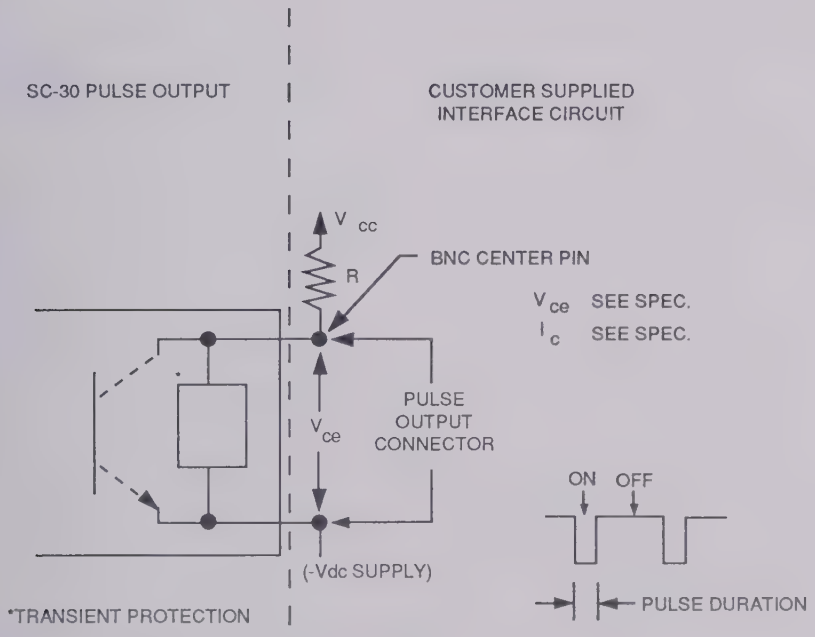

Figure 4.
Open Collector Parameters for Operation from an External Power Source

The voltage (V_{cc}) must be chosen so that the collector-to-emitter voltage (V_{ce}) listed in the specifications is not exceeded at any time during operation. The input characteristics of the external device must be considered in choosing the current-limiting resistor (R). V_{cc} and R must be selected so that a voltage level compatible with the external device exists when the transistor is not conducting.

CAUTION!
Do not connect a voltage exceeding 26 Vdc to the pulse outputs of the SC-30-RQ. A current-limiting resistor (R) must be used to limit the maximum collector current to the specified level.

Physical Description

Accuracy:

Watthour Accuracy Under Normal Operating Conditions

±0.05% / Power Factor traceable to the National Institute of Standards and Technology (NIST) and to Physikalisch-Technische Bundesanstalt (PTB)

Varhour Accuracy Under Normal Operating Conditions

±0.10% at 100% Output which is 90°(0.0) Lagging Power Factor and at 50% Output which is 30°(0.866) Lagging Power Factor, traceable to the National Institute of Standards and Technology

Qhour Accuracy Under Normal Operating Conditions

±0.10% at 100% Output which is 60°(0.5) Lagging Power Factor and at 50% Output which is 0°(1.0) Unity Power Factor, traceable mathematically through Watthours and Varhours:
$Qh = ((\sqrt{3}Varh) + Wh) / 2$

Specifications (cont.)

Normal Operating Conditions:	
Potential Input	
Operating Range	60 to 600 Vrms
Frequency	Watthour, 60 ±2 Hz *
	Varhour & Qhour, 60.00 Hz *†
Maximum Continuous Voltage	600 Vrms
Current Input	
SC-30-RQ Model	
Operating Range	0.2 to 50 Amps rms / Input
Frequency	Watthour, 60 ±2 Hz *
	Varhour & Qhour, 60.00 Hz *†
SC-30CT-RQ Model	
Operating Range	0.2 to 150 Amps rms
Frequency	Watthour, 60 ±2 Hz *
	Varhour & Qhour, 60.00 Hz *†
Auxiliary Power Input	
Operating Range	80 to 520 Vrms
Frequency	48 to 62 Hz
Temperature	
Ambient	23°C ±3 °C
Relative Humidity	10% to 95%, non-condensing (@ 35°C)
Orientation	Unrestricted

* 50 Hz operation optional

† For more information about this subject, see footnotes on Page 5 of this manual.

Physical Description

Specifications (cont.)

Influences Affecting Accuracy:	
Temperature	
Watthour Coefficient	0.003% / °C, maximum, -20°C to +70°C
Varhour & Qhour Coefficient	0.01% / °C, maximum, -20°C to +70°C
Operating Range	-20°C to +70°C
Storage Range	-40°C to +85°C
Stability	
Watthour	±0.05% / year, maximum
Varhour & Qhour	±0.10% / year, maximum
Magnetic Field Withstand	Meets or exceeds IEEE Standard as defined in ANSI C12-1975, Section 5.1.8.10
Waveform	
Distortion on the voltage waveform will result in a reduction of accuracy proportional to the quantity, order and magnitude of harmonics and the	presence, magnitude and phase of matching harmonics on the current input. To minimize waveform errors the voltage waveform should be sinusoidal.

Specifications (cont.)

Protection:	
Isolation	All combinations (Inputs, Outputs, Case) except Gate Input to High Pulse Output
Dielectric	2.3 kVrms, 60 Hz, for one minute
Surge Withstand	Meets ANSI/IEEE C37.90.1-1974
Physical Dimensions:	
Size	
Height	8.39" (213 mm)
Width	6.63" (169 mm)
Depth	6.61" (168 mm)
Weight	
SC-30-RQ Model	9.0 lbs. (4.08 kg)
SC-30CT-RQ Model	7.8 lbs. (3.54 kg)

Instruction Manual

Physical Description

Unpacking

The shipping container for the SC-30-RQ Multifunction Field Standard has been specifically designed for maximum protection of the product during shipment. It has been certified to withstand all applicable shipping conditions as described in the National Safe Transit Shipping Test. If shipping damage does occur, notify both your carrier and JEMTEC.

Since the majority of the circuitry are surface-mounted devices, it is recommended that the SC-30-RQ be returned to the factory for all repairs. For return authorization or further service information, contact your local JEMTEC representative or JEMTEC's Customer Support Group.

WARNING!
Unauthorized service or opening of the unit may void the factory warranty. The only user-serviceable parts are the potential and auxiliary power fuses, replaceable from the top-panel fuseholders.

The SC-30-RQ's autoranging function eliminates the possibility of applying power to the incorrect range; however, should a problem occur, the SC-30-RQ is fuse protected on its voltage and auxiliary power inputs. Should a blown fuse occur, replace only with a fuse of the same type and value. Information on the exact fuse type and value is located in the Specifications Section of this manual. Over-fusing may result in damage to the unit and interruption of service.

Installation

Many different electrical test configurations can be set up using the SC-30-RQ. See the "Connection Diagrams" section of this manual for illustrations of several test configurations.

A basic installation will be discussed here, but for a thorough discussion of meter testing techniques, the *Handbook for Electricity Metering, Eighth Edition*, Edison Electric Institute, Washington D.C. is recommended.

WARNING!
Note and practice the safety recommendations listed in Chapter 15, "Watthour Meter Testing and Maintenance," in the *Handbook for Electricity Metering, Eighth Edition.*

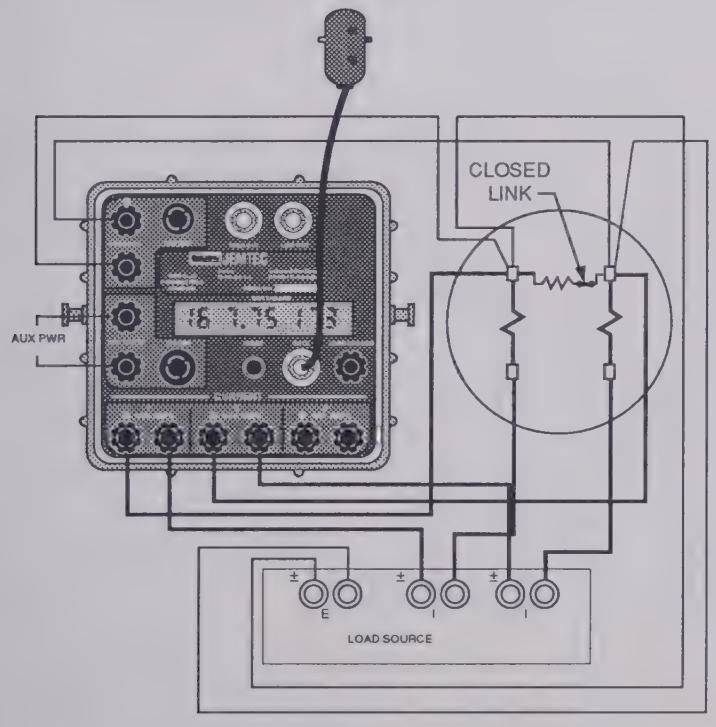

Figure 5.
Fundamental Meter Test Circuit

Instruction Manual

General Operation

Installation

1 Connect the SC-30-RQ to a proper auxiliary power source.

> **WARNING!**
> **If connections are made, changed, or broken with the current source turned on, dangerously high voltages can be developed, with attendant shock hazards. For personnel protection, no source should be turned on while connections are being made, changed, or broken.**

2 Connect the SC-30-RQ potential terminals to a source of potential. Connect the potential coil(s) of the meter under test directly to (in parallel with) the same source of potential. Connect the Snap Switch to the gate input as it is shown in Figure 5, "Fundamental Meter Test Circuit."

3 With the current source turned off, connect the current coils of the SC-30-RQ and the current coils of the meter under test in series with the source as shown in Figure 5, "Fundamental Meter Test Circuit."

When power is properly applied to the SC-30-RQ, all segments of the LCD display will appear.

The standard will then perform its self-diagnostic tests on the power supply, internal RAM, and EEPROM.

A message of Hold XX (where XX is a countdown) will be displayed while the SC-30-RQ standard stabilizes its electronics.

When the countdown reaches 0 (zero), the Standard will display CHOOSE, indicating the desired measurement function, Watthours, Varhours or Qhours must be selected. By pressing the Reset/Choose button, the display will begin flashing a colon directly beneath the word *WATTHOURS* on the unit's control panel.

At this point, if Watthours is the desired measurement function, wait 6 seconds and the SC-30-RQ will engage this function.

Installation (cont.)

If Varhours are required, press the Reset/ Choose button again (before the 6 seconds elapses). The colon is now flashing under the word *VARHOURS*. Once again, by waiting 6 seconds, the SC-30-RQ will automatically engage the indicated function.

Qhours are handled exactly the same as Watthours and Varhours.

If the desired function is passed over, just continue to press the button and the selections will be repeated.

Changing measurment functions after one has been selected is performed by pressing the Reset/Choose button for 3 seconds. The SC-30-RQ will then display CHOOSE with the colon flashing beneath the currently active function. Repeat the process just outlined to change functions. Once a function is engaged, the display will show 0.00000.

The SC-30-RQ displays eight digits of data with the digit to the left of the floating decimal point being in Watthours, Varhours or Qhours, (the function currently engaged) that is, K_h = 1.0.

When the SC-30-RQ is not measuring energy, the colon that was used earlier to select the desired measurement quantity will begin flashing again directly beneath the appropriate word, *WATTHOURS*, *VARHOURS* or *QHOURS*. As soon as a test has begun, the colon will be extinguished.

If any diagnostic tests fail, an error code Error XX (where XX is a coded indication of the specific failure) will appear, and the SC-30-RQ will become inactive.

Since the SC-30-RQ is intended for unidirectional energy measurement, it will not register energy if proper phasing is not observed. If the SC-30-RQ is improperly phased, the readout will display POL. indicating reverse polarity. If this occurs, turn off the load source and reverse either the potential or the current leads at the SC-30.

Pulse outputs are not active if the potential input voltage drops below 50 Vrms, in which case the SC-30-RQ will cease operation and display Lo Pot.

Testing Instructions

This section of the manual is divided into two sets of instructions. One set of instructions explains the step-by-step procedures for testing an Electro-mechanical Meter. A second set of instructions explains the step-by-step procedures for testing a Solid-State Meter using a Presettable Test Counter.

The SC-30-RQ normally supports Gated Input Tests only. The LCD display will accumulate energy only if the voltage input exceeds 50 Vrms and proper phase is applied and the gate input receives and maintains closed contacts.

Switched potential operation is not recommended for Varhour and Qhour measurements due to error producing transients introduced into the phase standards during potential switching.

Testing Electromechanical Meters

1 Attach a Snap Switch to the gate input of the SC-30-RQ and make the necessary connections as described in the "Installation" section of this manual.

2 Start the standard by closing the Gate Input (i.e., activate the Snap Switch) at the precise moment that the mark (flag) passes a particular point on the meter frame. The SC-30-RQ will begin measuring energy and displaying the accumulated amount of energy on the LCD display.

Note: If an error occurs after theSnap Switch has been activated, the SC-30-RQ's display will indicate Retry. Deactivate the Snap Switch and repeat Step 2. The SC-30-RQ will automatically reset to 0.00000 (zero) and start over.

Testing Electromechanical Meters (cont.)

3 Stop the standard by deactivating the Snap Switch at some precise number of disk revolutions (typically 10 or more). The SC-30-RQ will then cease accumulating energy. Ten or more revolutions are recommended to minimize any errors due to human observation.

Note: If a pulse counting device is attached to one of the pulse outputs, it will continue to register pulses. The pulse outputs <u>are</u> affected by the state of the Gate Input. Do not operate the Gate in the pulse output mode.

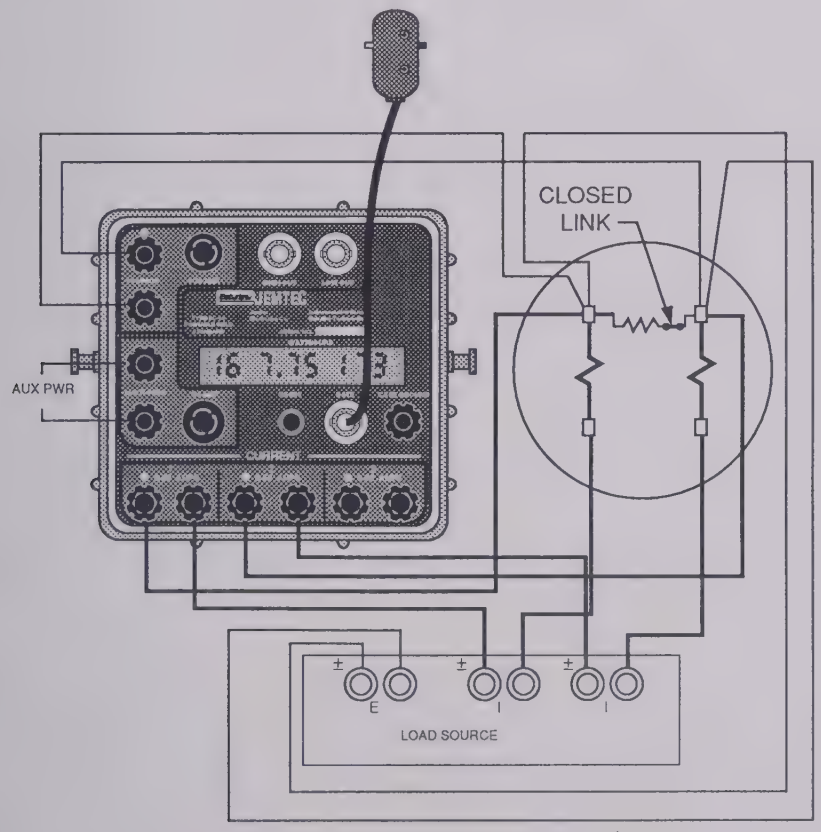

Figure 6.
Connections and Setup of a Electromechanical Meter

Testing Instructions

Testing Electromechanical Meters (cont.)

4 The amount of energy measured by the standard can then be directly read in Watthours, Varhours or Qhours on the SC-30-RQ LCD display. The digit to the left of the decimal point indicates Watthours, Varhours or Qhours, whichever is selected.

5 Determine the percent registration of the meter under test using the following formula:

$$\%R = (N_t \times K_h) / (N_s) \times 100$$

or, as expressed more traditionally:

$$\%R = \frac{N_t \times K_h}{N_s} \times 100$$

$\%R$ = Percent registration

N_t = Number of disk revolutions from the meter under test

K_h = Value of Watthours, Varhours or Qhours per revolution

N_s = Number of Watthours, Varhours or Qhours from the standard

Multiplying N_t (the number of meter disk revolutions) by K_h (the value of Watthour, Varhour or Qhour per revolution) will give you the amount of energy recorded by the electromechanical meter.

Example:

$$\%R = \frac{\text{Watthours recorded by electromechanical meter}}{\text{Watthours recorded by SC-30-RQ}} \times 100$$

$$\%R = \frac{10 \text{ Revolutions} \times 7.2 \text{ Watthours}}{71.856} \times 100 = 100.2\%$$

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Testing Instructions

Testing a Solid-State or an Electromechanical Meter Using a Presettable Test Counter

1 Attach a Presettable Test Counter (PTC) to the Gate Input of the SC-30-RQ and make the necessary connections as described in the "Installation" section of this manual and the PTC instruction manual.

2 Make the connections as shown in Figure 7 below.

3 Set the Presettable Test Counter (PTC) for the number of test counts (N_t) desired from the meter or unit under test.

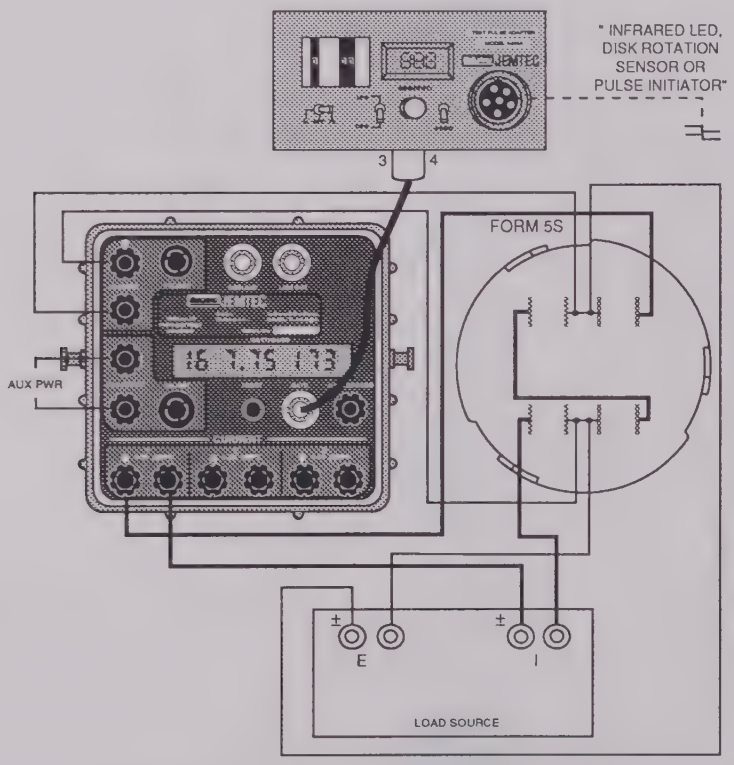

Figure 7.
Connections and Setup of a Solid-State or an Electromechanical Meter Using a Presettable Test Counter

Testing a Solid-State or an Electromechanical Meter Using a Presettable Test Counter (cont.)

4 Actuate the PTC's start button or start switch to begin the test. This will tell the PTC to close its control relay output, giving the SC-30-RQ a "Snap Switch" closure at its gate input. The PTC will then count down the Number of Test Counts (N_t) entered and upon reaching zero, will open its control relay output telling the SC-30-RQ that the test is completed.

5 Read the amount of energy in Watthours, Varhours or Qhours on the SC-30-RQ LCD display. The digit to the left of the decimal point indicates Watthours, Varhours or Qhours.

6 Determine the Percent Registration of the Meter under Test by using the following formula:

$$\%R = (N_t \times K_h) / (N_s \times \text{N Elements}) \times 100$$

%R = Percent registration

N_t = Number of pulses or rotations from the meter under test

K_h = Value of Watthours, Varhours or Qhours per pulse or rotation

N_s = Number of Watthours, Varhours or Qhours from the standard

N Elements = Number of Elements, 1, 2 or 3, in Test Meter. For 2.5 Element meters, use 4 for N Elements

Note: If the pulse output of the Test Meter is 3 wire, Form C (KYZ), and the Gate Input of the Test Counter is 2 wire, Form A (KY or KZ), the value of N_t must be double in the above equation. This is because only one-half of the output pulses (transitions) were seen by the Test Counter.

Testing Instructions

Testing a Solid-State or an Electromechanical Meter Using a Presettable Test Counter (cont.)

For example, suppose the meter under test has a K_h of 0.6, and the number of pulses or rotations selected for the test (N_t) is 10. If, at the end of the test, the SC-30-RQ displayed 5.99460, the percent registration (%R) would be 100.09.

This is interpreted as meaning the meter tested registers 0.09% fast.

The following list includes the Display Messages that may appear on the SC-30-RQ.

- The left column is the display message.
- The right column is an explanation of the message and the action you need to take.

Display Message	Explanation/Action
CHOOSE	Select Watthours, Varhours or Qhours by pressing the Reset/Choose button.
Lo Pot	Potential (voltage) is below 50 Vrms. Apply normal voltage and start over.
POL.	Polarity is reversed. Turn off the load source and reverse either the potential or the current connection.
Retry	Repeat the test.
Hold XX	SC-30-RQ is running diagnostics. Wait for completion of countdown.
Error XX	Cycle the power off for 10 seconds, and then power up. Repeat the test. If the message reappears, record the Error Number and call JEMTEC's Customer

Connection Diagrams

Support Group at (614) 274-0400. Select the proper connection diagram, depending on the type of meter you are testing. The test configurations are as follows:

Figure	Description
8	SC-30-RQ for Electromechanical Meters
9	SC-30CT-RQ for Electromechanical Meters
10	SC-30-RQ for Closed-Link Testing of Electromechanical Meters
11	SC-30CT-RQ for Closed-Link Testing of Electromechanical Meters
12	SC-30-RQ Testing an Electromechanical Standard
13	SC-30CT-RQ Testing an Electromechanical Standard
14	SC-30-RQ and PTC for Electromechanical or Solid-State Meters
15	SC-30CT-RQ and PTC for Electromechanical or Solid-State Meters
16	SC-30-RQ and PTC for Closed-Link Testing of Electromechanical Meters
17	SC-30CT-RQ and PTC for Closed-Link Testing of Electromechanical Meters

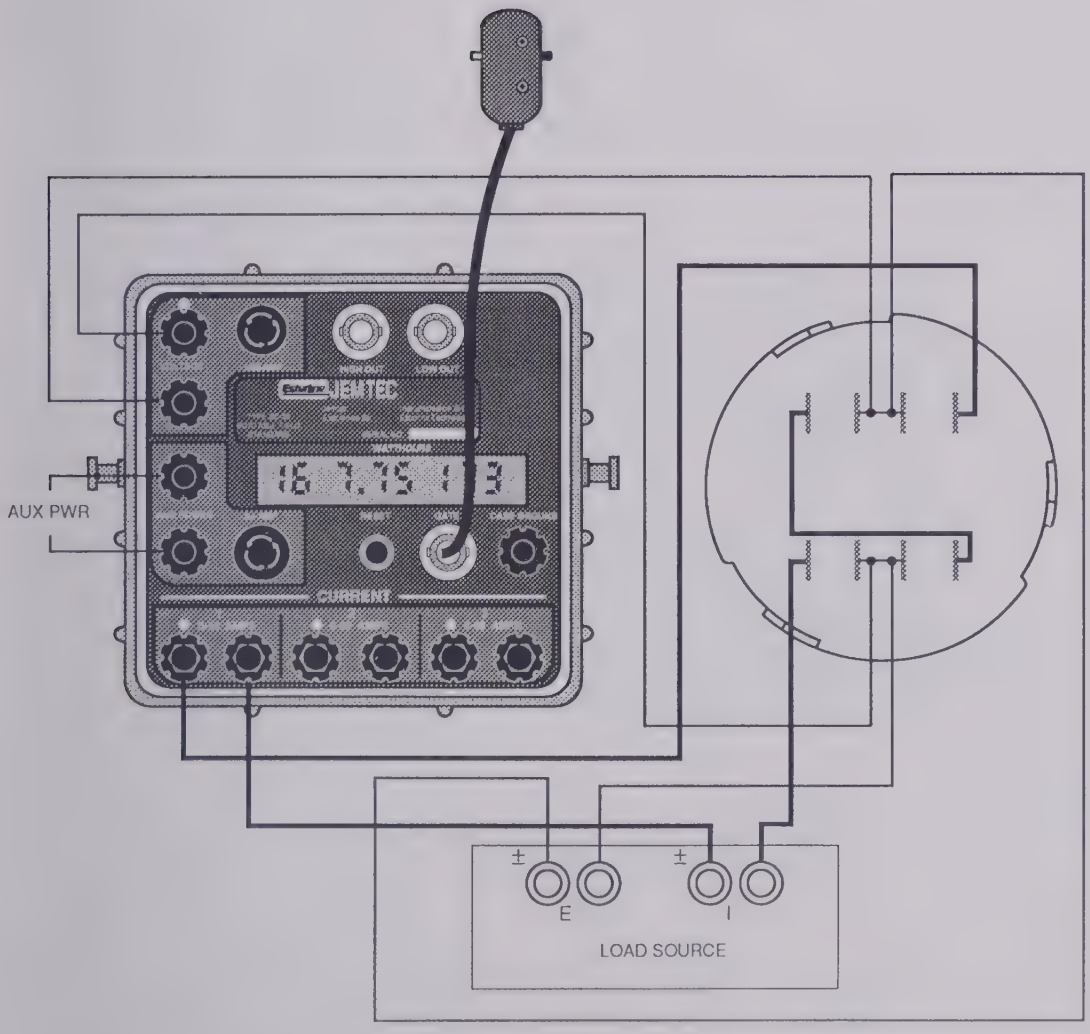

Figure 8.
SC-30-RQ for Electromechanical Meters

Connection Diagrams

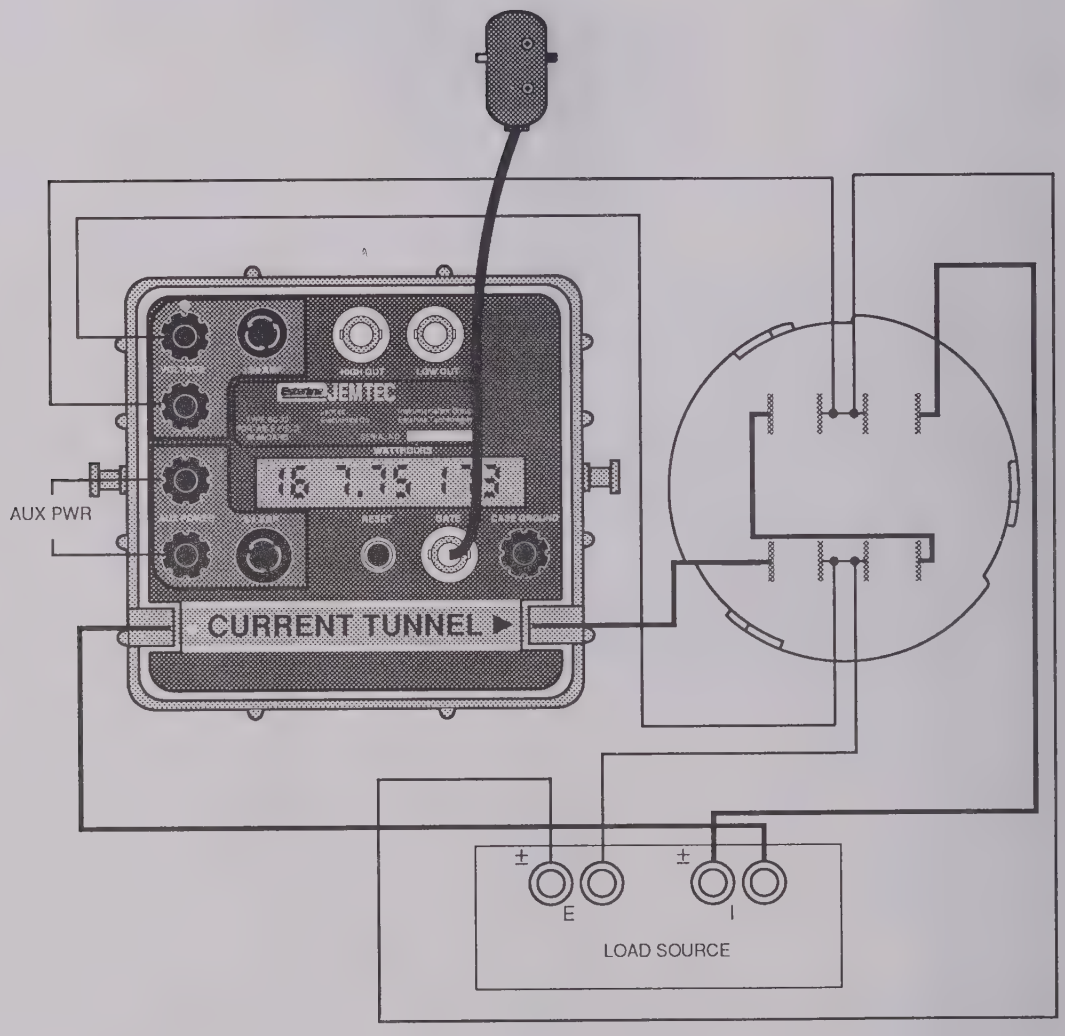

Figure 9.
SC-30CT-RQ for Electromechanical Meters

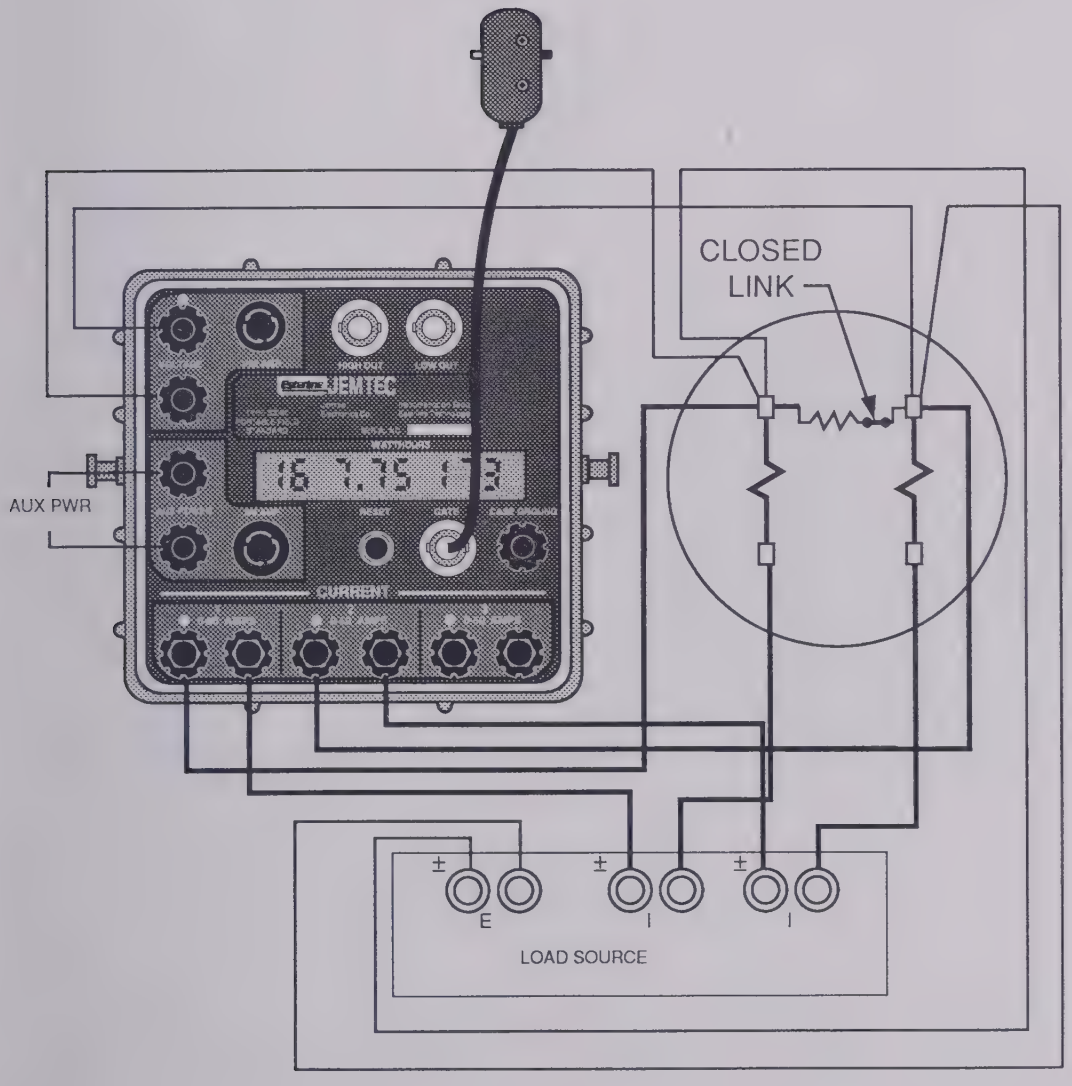

Figure 10.
SC-30-RQ for Closed-Link Testing of Electromechanical Meters

Connection Diagrams

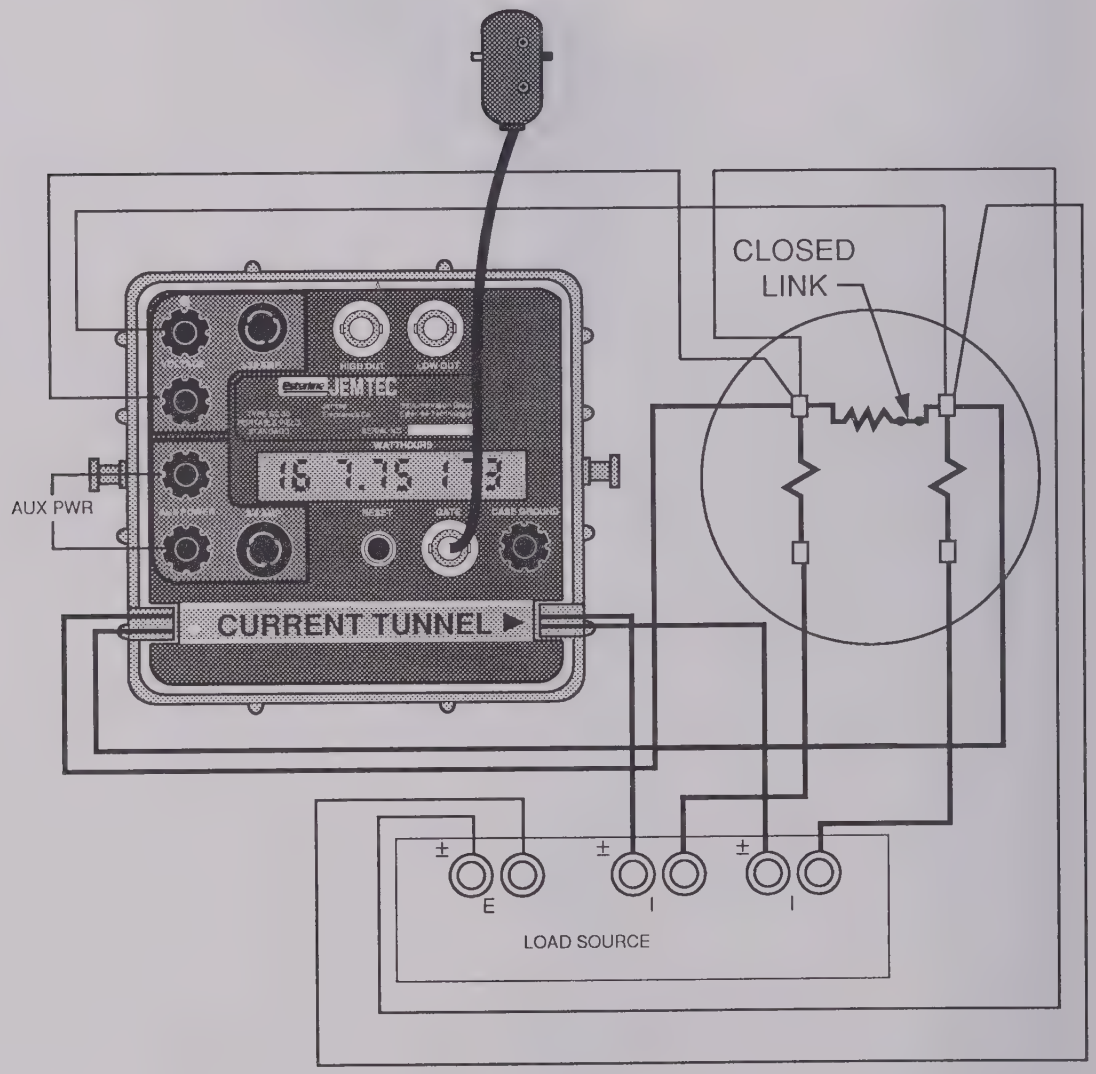

Figure 11.
SC-30CT-RQ for Closed-Link Testing of Electromechanical Meters

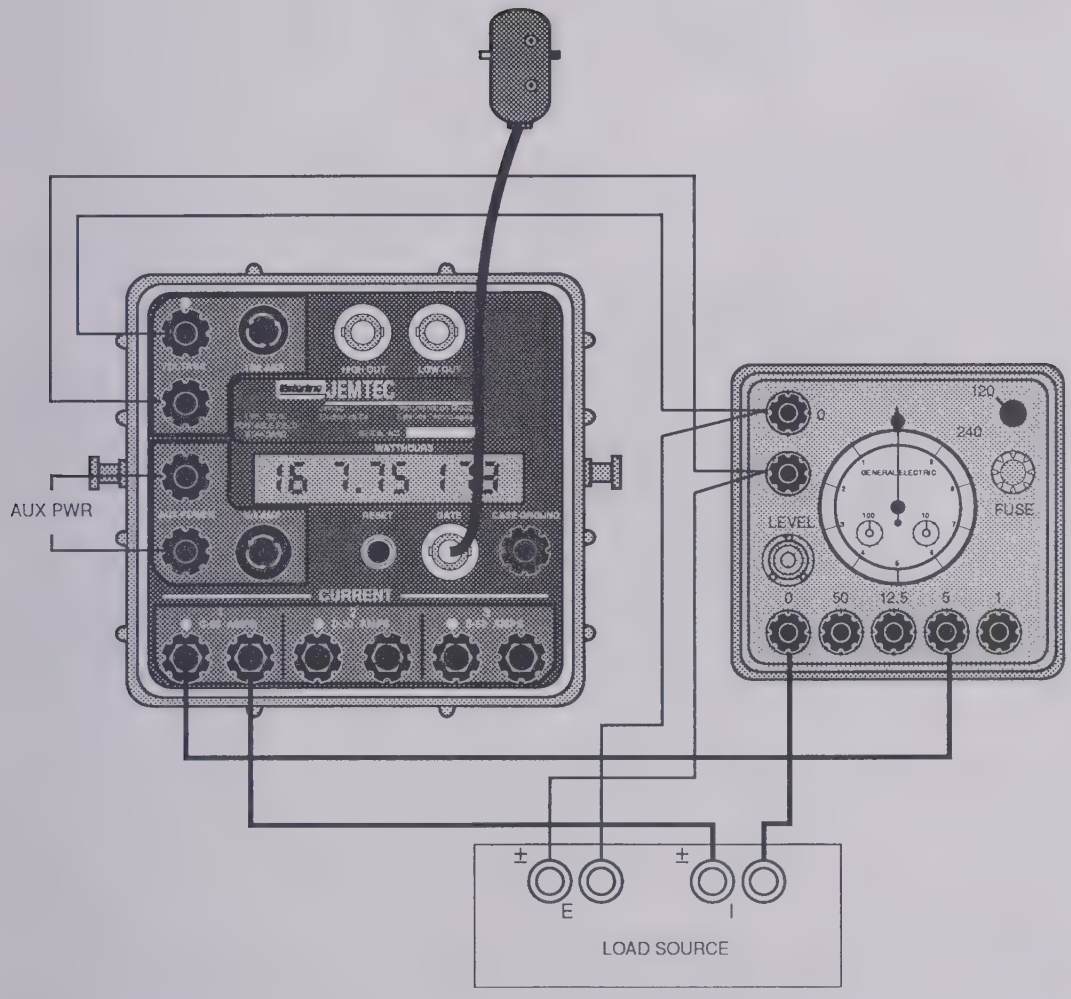

Figure 12.
SC-30-RQ Testing an Electromechanical Standard

Connection Diagrams

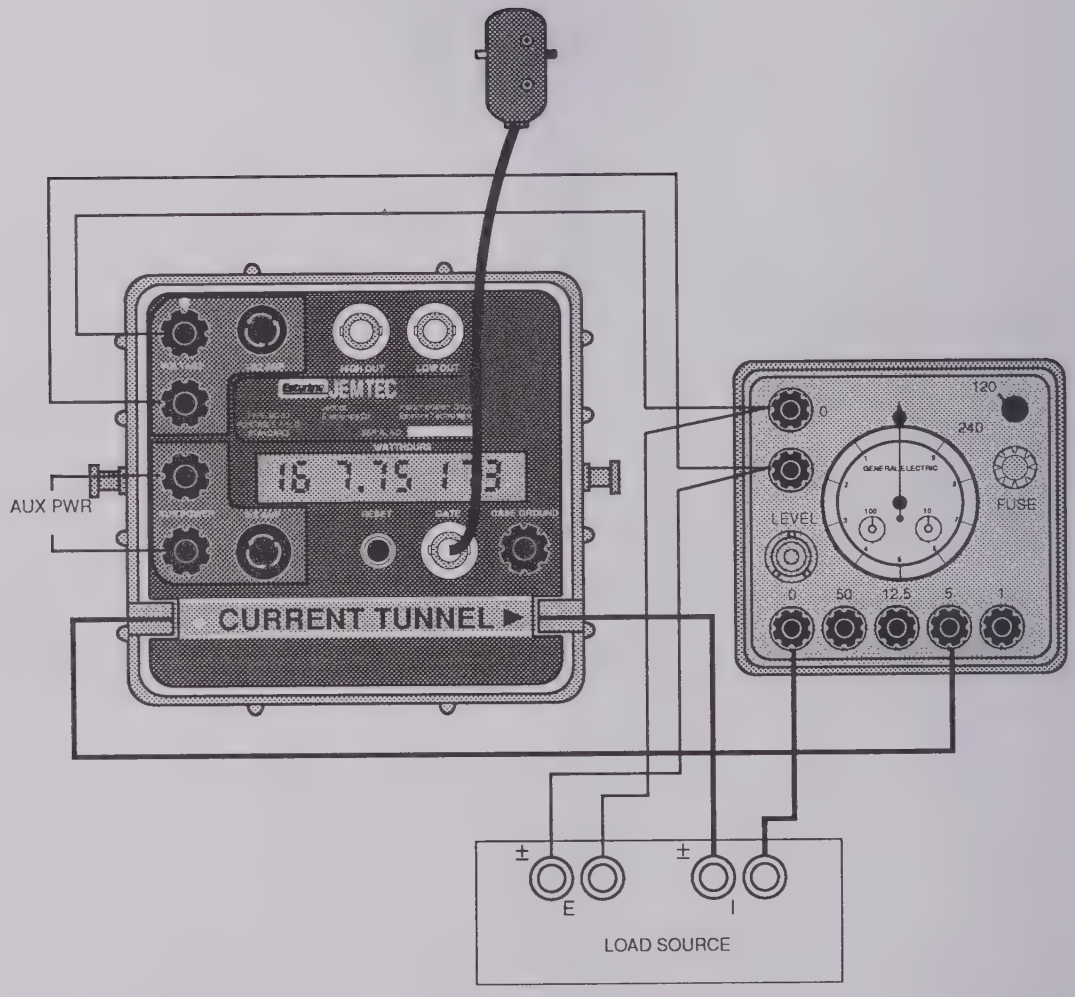

Figure 13.
SC-30CT-RQ Testing an Electromechanical Standard

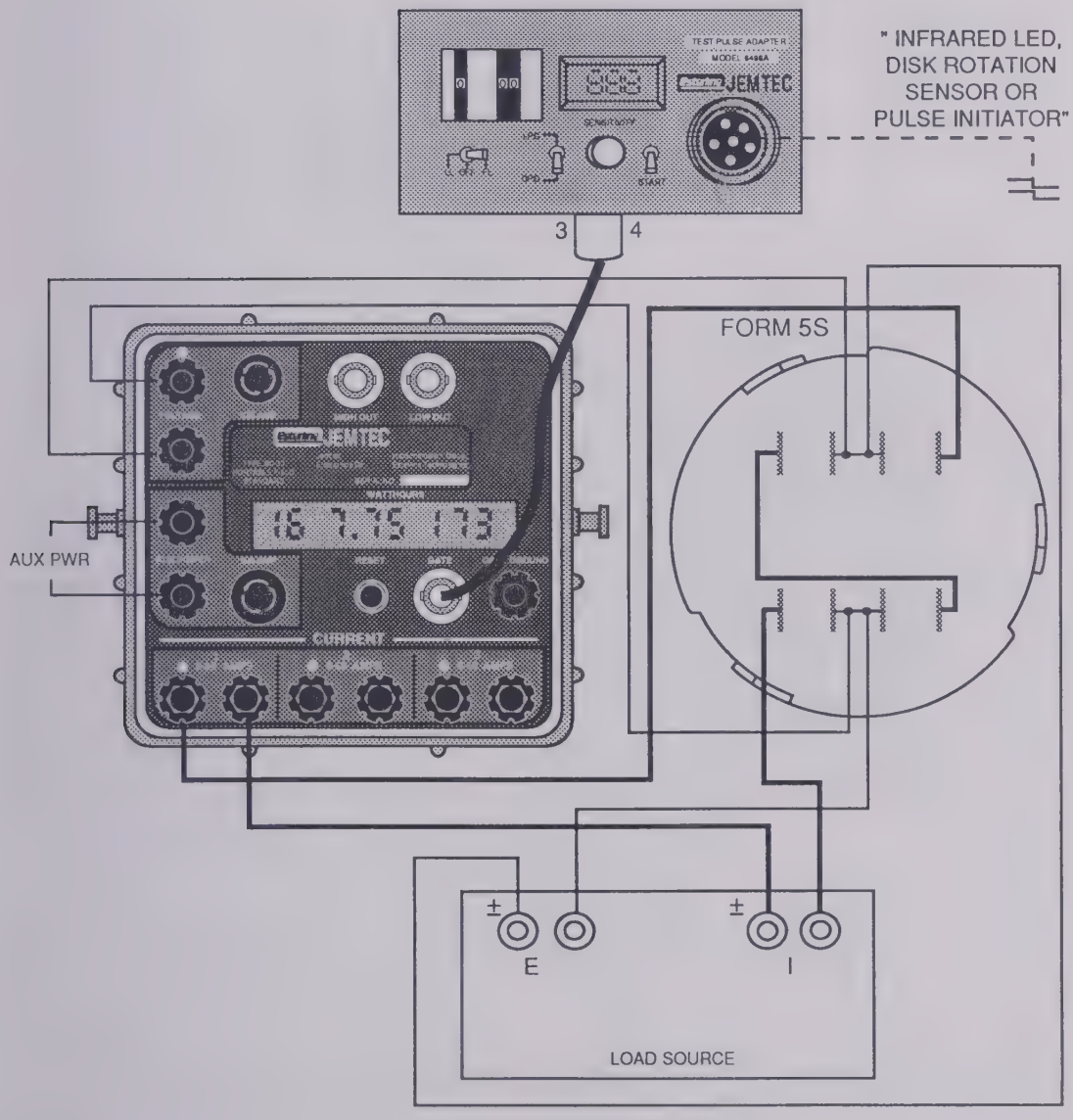

Figure 14.
SC-30-RQ and PTC for Electromechanical or Solid-State Meters

Connection Diagrams

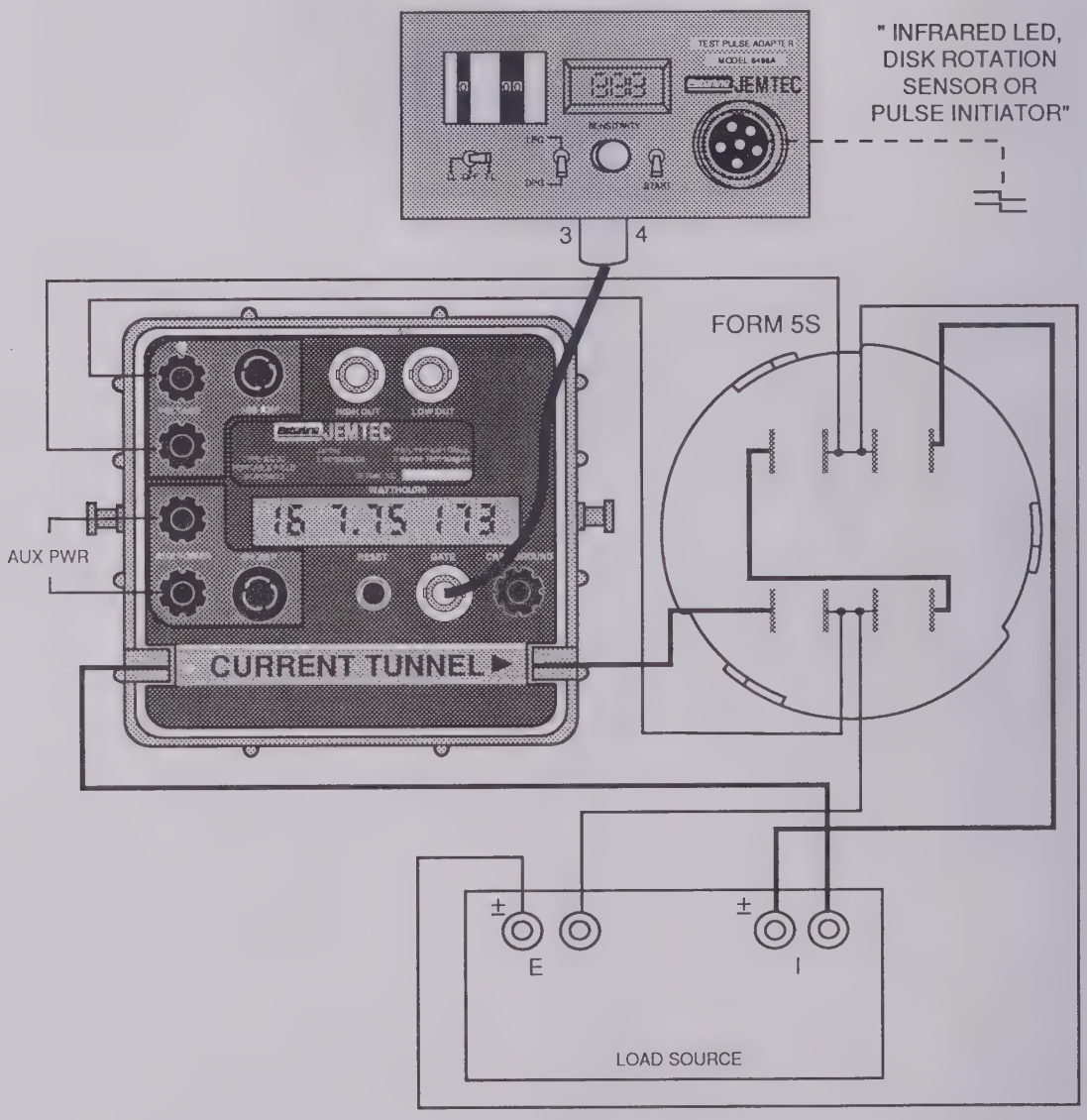

Figure 15.
SC-30CT-RQ and PTC for Electromechanical or Solid-State Meters

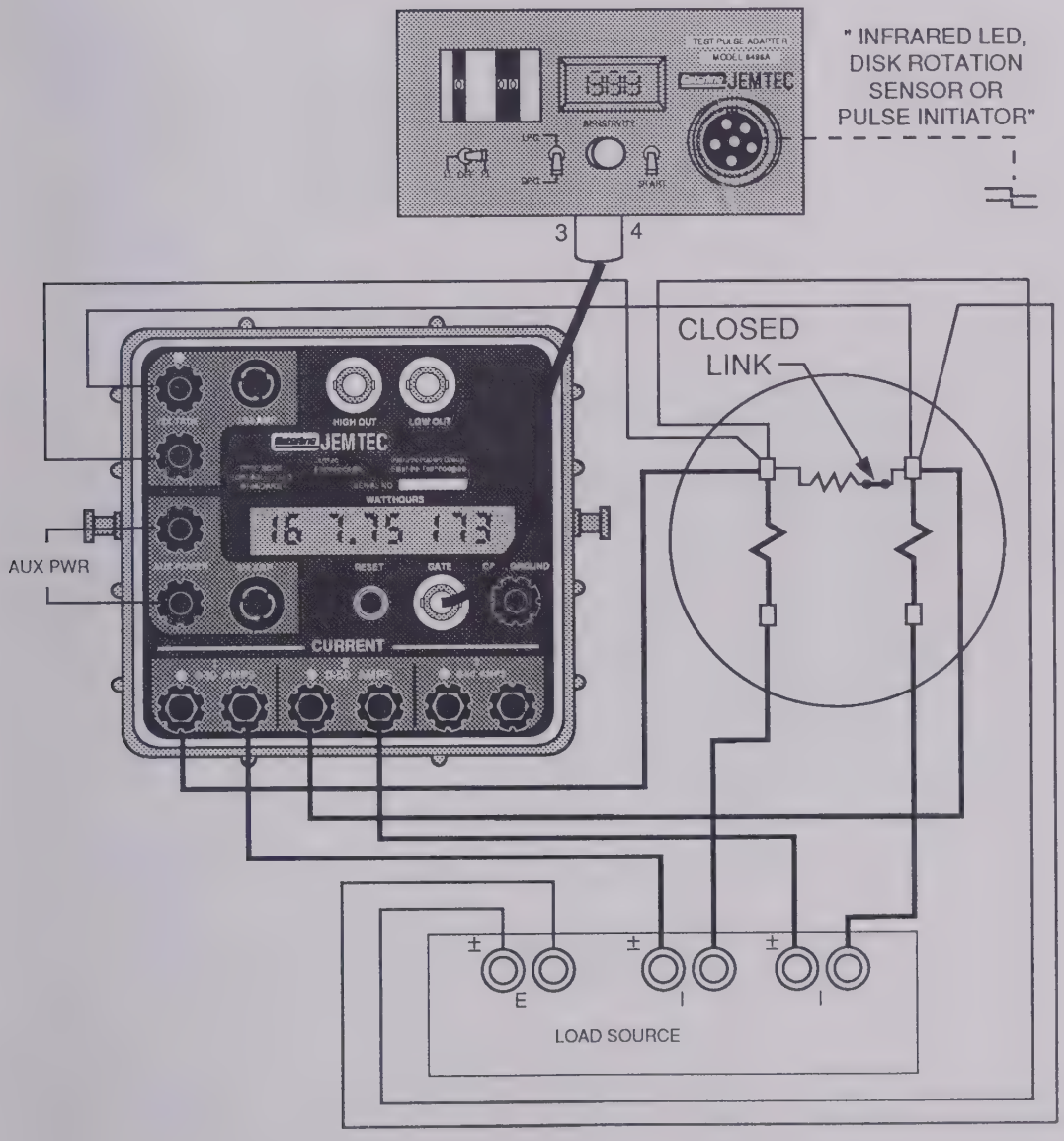

Figure 16.
SC-30-RQ and PTC for Closed Link Testing of Electromechanical Meters

Connection Diagrams

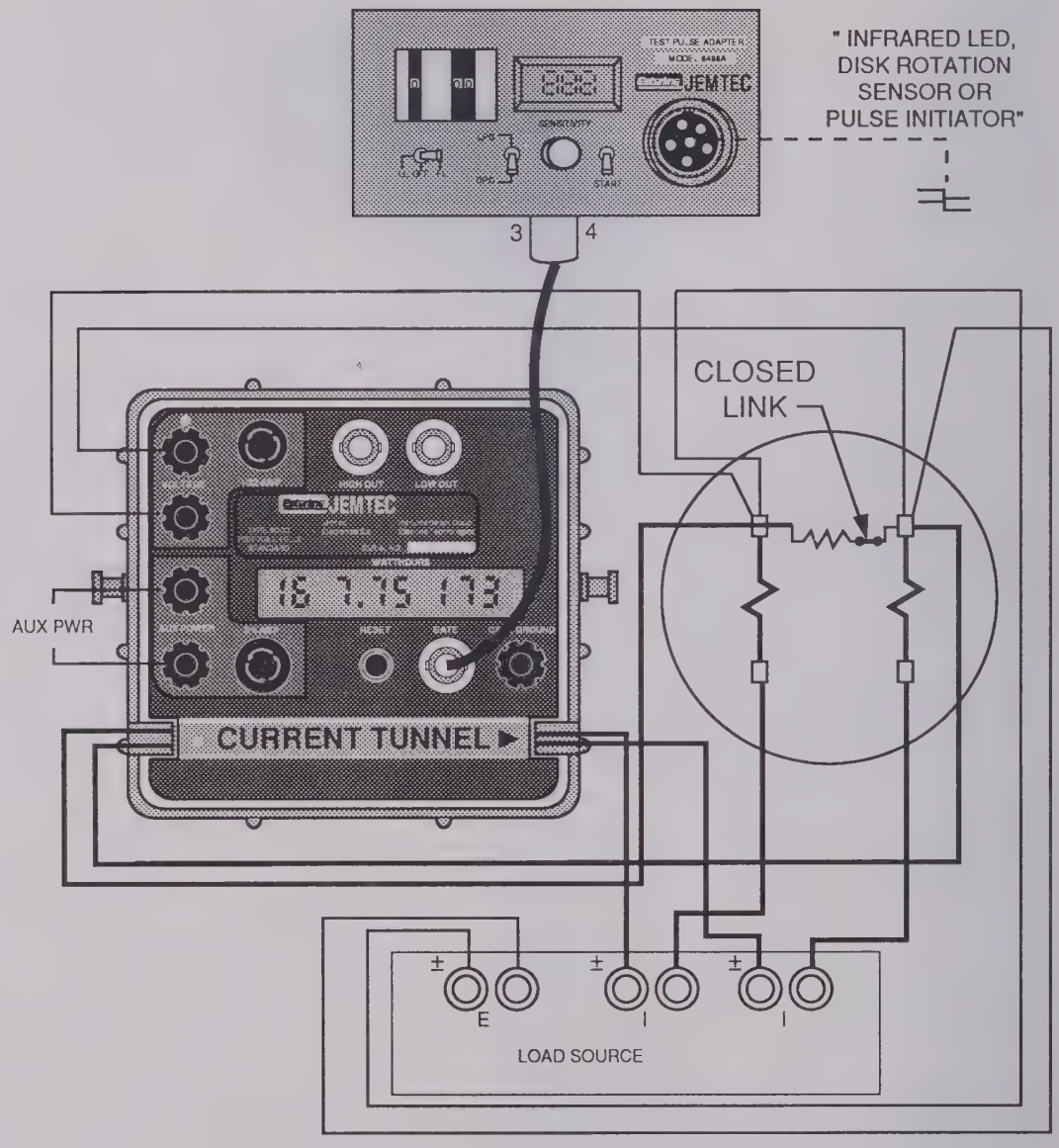

Figure 17.
SC-30CT-RQ and PTC for Closed Link Testing of Electromechanical Meters

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